Appendix B

Bull Run Fish Passage Alternative Technical Memorandum

Bull Run Fish Passage Alternative

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DATE: May 22, 2007

Introduction

This technical memorandum has been prepared to support the NEPA DEIS for the Bull Run Water Supply Habitat Conservation Plan (Bull Run HCP) being developed by the City of Portland Bureau of Water Works (the City). The City and Services have selected fish passage past Bull Run Dams No. 1 and No. 2 as a habitat conservation measure to be considered in the DEIS. The intent of this alternative is to collect migrating adults below the Bull Run Dams and pass the fish upstream in a manner that maximizes the use of available habitat. Juvenile outmigrants would also be collected and conveyed past the two dams.

Background

At the City's request, CH2M HILL and R2 Resource Consultants, Inc. reviewed previous studies of the fish production potential upstream of the headworks area, including Fisheries Consultants (1998, 2003); City of Portland and Mobrand Biometrics (2004); and CH2M HILL (2005). The consulting team then developed and evaluated an alternative for fish passage that would maximize fish production.

Previous assessments evaluated the production potential for four stocks of anadromous fishes upstream of the Bull Run River dams including both the spring and fall races of Chinook salmon, coho salmon, and winter steelhead trout. Fisheries Consultants (1998) considered habitat upstream of the Bull Run River dams to have a small salmon and steelhead production capacity as compared to many other river basins in the Pacific Northwest. The Bull Run watershed was estimated to have a production potential on the order of 1,000 to 2,500 fish. Fisheries Consultants (1998) also states: *"for other projects where anadromous fish re-establishment has been considered above existing dams, total estimated annual production of Chinook salmon, coho salmon and steelhead trout has ranged from 1,000 to 45,000 fish."*

An Ecosystem Diagnosis and Treatment (EDT) model developed for the Bull Run watershed provides another assessment of environmental constraints on the salmonid population (City

of Portland and Mobrand Biometrics [2004]). The model results predict low production potentials for accessible Bull Run stream reaches (on the order of 5,000 fish), even when a passage efficiency of 100 percent is assumed. A summary of the upper river abundance estimates (spawning escapement) from various references are shown in Table 1.

Table 1
Adult Abundance Estimates Upstream of the Bull Run Dams

Species	Adult Abundance (Spawning Escapement)		
	Fisheries Consultants (1998)	EDT Model	HCP Modified Historical Condition
Fall Chinook	-	997	6,670
Spring Chinook	500 - 1,500	1,983	6,490
Coho	-	893	2,552
Winter Steelhead	500 - 1,000	856	3,880
Total Anadromous Salmonid Fishes	1,000 - 2,500	4,729	19,592

The EDT abundance estimates reflect more fish stocks and a greater number of accessible habitat miles than earlier estimates provided by Fisheries Consultants (1998). Aggressive assumptions in the City's Bull Run HCP Modified Historical Condition likely overestimate production potential.

The distribution of accessible stream reaches for up to four anadromous fish stocks is shown in Figure 1. Distribution values of 1 to 4 indicate how many of the four anadromous species (spring Chinook, fall Chinook, coho salmon, and winter steelhead trout) were assumed to historically use these reaches, and where future use may be facilitated by fish passage past the dams.

The figure shows the relative importance of low gradient areas, where tributary channels enter the mainstem Bull Run River or the reservoirs. Low-gradient stream reaches offer more productive habitat conditions for salmonid fishes than steeper upstream areas. For example, more species were predicted to use lower reaches such as South Fork Bull Run River, reach 1; an unnamed east tributary, reaches 1 and 2; Cougar, reach 1; North Fork Bull Run River, reach 1; Fir Creek, reach 1 and 2 and so on.

Whereas potential habitat production is generally on the low to moderate side, the reaches contributing to potential species distributions are reasonably diverse (widespread), including in-between and above Dams No. 1 and No. 2. For instance, the South Fork Bull Run River enters the mainstem Bull Run River between Dams No. 1 and No. 2. The South Fork is anticipated to generate a large proportion of the up-river production potential (City of Portland and Mobrand Biometrics [2004]).

Based on the review of available biological information and the distribution of potential fish species, we conclude that the fish passage alternative should provide access to all of these reaches for an optimum fish re-establishment approach. From a fisheries management perspective and based on our experience with fish passage alternatives at other sites in the region, we conclude that the adult fish passage operations should return fish upstream to both reservoirs to allow fish volitional movements to tributary and mainstem habitats. Potential migration barriers that exist upstream of Reservoir No. 1 in the mainstem Bull Run

river may limit the upstream distribution of many of the anadromous species; however, according to resource agency site visits, winter steelhead were judged to be capable of passing the barriers during certain flow periods (Steve Kucas, personal communication [2007]).

On the basis of this information, we recommended that the preferred passage alternative consist of upstream adult fish passage facilities and downstream juvenile fish passage facilities at both dams. Due to existing water supply infrastructure, facilities at Dam No. 2 should bypass the short reach between Dam No. 2 and the Rock Weir (Settling Dam).

Purpose

The purpose of this memorandum is to present a description of the fish passage facilities that would be required as part the preferred alternative and to support development of the NEPA DEIS for the Bull Run HCP.

Fish Passage Facilities

Upstream and downstream fish passage facilities were considered at Bull Run Dam No. 1 and Bull Run Dam No. 2 as follows:

Upstream Adult Fish Passage:

- Rock Weir Fish Collection and Transportation Facility
- Bull Run Dam No. 1 Fish Collection and Transportation Facility

Downstream Juvenile Fish Passage:

- Bull Run Reservoir No. 1 Surface Collector
- Bull Run Reservoir No. 2 Surface Collector

This arrangement allows fish access to all reaches in the watershed (except the short reach between Dam No. 2 and the Rock Weir), and allows fish to volitionally return to both tributary and mainstem habitats. The escapement estimates provided by the EDT model were used for the purposes of this evaluation.

It is anticipated that impacts to existing water supply and hydropower infrastructure would be minimal. Descriptions of the proposed fish passage facilities are provided below, including conceptual construction and project costs.

Upstream Fish Passage

We recommend that fish collection and transportation (trap and haul) facilities be provided to allow migrating adult fish to move upstream past Bull Run Dam No. 2 and Bull Run Dam No. 1. Trap and haul is considered a standard technology for providing fish passage past dams with heights in excess of 100 feet, or when reservoirs with large forebay water surface elevation fluctuations have to be negotiated. The following is a discussion of the conceptual upstream fish passage facilities at each dam.

Rock Weir Fish Collection and Transportation Facility

The Bull Run No. 2 Dam is an earth and rock fill embankment with a maximum height of 145 feet and a crest elevation of 875 feet. The dam is located at Bull Run River mile 6.5. A Rock Weir (Settling Dam) located below the spillway stilling basin at river mile 5.8 has been identified as the upstream limit for fish passage within this reach.

The trap and haul facilities required at the Rock Weir would be similar to those described in a previous memorandum (Fisheries Consultants [1998]). The facility would include a fishway and trap located at the existing 15-foot high Rock Weir structure as shown in Figure 2. Fish would enter the fishway, ascend to the trap, be crowded into a hopper, and then be placed into a truck for transportation past Bull Run Dam No. 2. The facility water supply would operate by gravity from the stilling basin.

Design refinements to the previous fishway proposal include reducing the number of steps to fourteen based on available headwater and tailwater information. It is assumed that 20 cfs is the low river design flow and that 672 cfs is the high river design flow for the facility (Table 8-13, CH2M HILL [2007]). The low and high design flows would produce headwater elevations of approximately 676.5 feet and 678.1 feet respectively, and tailwater elevations of approximately 663 feet and 665 feet respectively.

The fishway type would be either pool-and-weir or vertical slot. It is assumed that the fishway would be designed for a minimum flow of 20 cfs and that the attraction water system would be designed for 80 cfs. It is anticipated that all flows in the river would be diverted through the fishway during the late summer season. Upstream migrating adults would be collected in a holding pool with a vee trap at the top of the fishway. If fish sorting, selective planting, and/or return downstream of the Rock Weir is required, the facility would become much more complicated.

It is assumed that collected fish would be crowded into a hopper, lifted across the existing buried water supply conduits via a monorail hoist, and then deposited into waiting fish trucks. The trucks would stage on a siding adjacent to the existing access road.

Fish would be transported to the boat ramp in the forebay of Bull Run Dam No. 2 and then released into the reservoir. A permanent fish return pipe may be required since the boat ramp does not extend to the low forebay level (approximately 20 feet below the normal high pool level), and to transport fish past any proposed surface collector guide nets. The return pipe may require a forebay pump station to provide adequate flushing water.

Design of a fishway at the Rock Weir would have to incorporate repair and modifications to the existing structure as currently considered by the City. The Rock Weir was constructed in 1965 and several floods since then have damaged the weir and adjacent settling basin. Preliminary repair concepts have been developed (URS Corporation [2005]) and the City is preparing final design documents. Recommended modifications to the proposed repair concept to accommodate fish passage include making the downstream apron fish-friendly and removing the proposed 36-inch diameter outlet pipe located on the right bank. This bypass function could be provided by the fishway.

Bull Run No. 1 Fish Collection and Transportation Facility

The Bull Run No. 1 Dam is a concrete arch dam with a maximum height of approximately 180 feet and a crest elevation of 1,050 feet. The dam is located at Bull Run River mile 11.1.

The trap and haul facilities required at Bull Run Dam No. 1 would be similar to those described above for Bull Run Dam No. 2. The facility would be located on the right bank immediately downstream of the powerhouse tailrace as shown on Figure 3. It is estimated that ten pools would be required to allow migrating adults to ascend high enough to be trapped above the flood stage. A gravity water supply is not available to run this facility, so all of the fishway and attraction water would be pumped from the tailrace. A tailrace barrier may be required to prevent fish from being falsely attracted to the powerhouse tailrace or outlet works on the left bank.

The maximum draw down in Reservoir No. 1 is 90 feet, so the fish return pipe system would need to cover an even broader range of reservoir levels than that required for Reservoir No. 2.

Downstream Fish Passage

It is recommended that floating surface collectors (gulpers) be used to provide downstream passage for migrating juvenile fish at Bull Run No. 1 and Bull Run No. 2. Surface collectors are typically used when large fluctuations in the reservoir forebay water surface elevations make fixed screens unfeasible. Similar technology has been used successfully at Puget Sound Energy's Baker River Project and is being considered for the PacifiCorp Lewis River project. The following is a discussion of conceptual downstream fish passage facilities at each dam.

Bull Run No. 1 Surface Collector

The outlet works at the Bull Run No. 1 Dam include a power intake with a selective withdrawal tower, a gated outlet with three 36-inch diameter needle valves and an overflow spillway. The powerhouse located at the toe of the dam has an installed capacity of 24 MW.

Operating levels in the Bull Run No. 1 Reservoir (Lake Ben Morrow) can fluctuate 70 to 90 feet, but typically vary 55.5 feet between approximate elevation 990.0 and the gated spillway elevation of 1,045.5.

A Baker-type gulper would be placed in Bull Run No. 1 Reservoir as shown in Figure 4. A gulper is a floating surface collector with guide nets placed in a reservoir to provide migrating juvenile fish a downstream passage preferable to power or water supply intakes. The gulper is comprised of a floating barge with low head pumps to create attraction flows. For the purposes of this evaluation, it was assumed that the Bull Run No. 1 gulper would draw approximately 500 cfs from the surface of the reservoir. The proposed attraction flowrate and position of the gulper would have to be confirmed through hydrodynamic modeling, physical modeling and/or prototype testing during final design. Fish are guided by the nets to the collector and drawn into a criteria vee screen. The fish are then routed into a bypass pipe and continue on to a fish transfer facility where they are loaded into trucks.

The gulper would be secured with cables and motorized winches which could be adjusted to accommodate forebay fluctuations. Air-filled bladders supporting the guide nets would be deflated to allow floodwaters and debris to pass unimpeded.

The fish transfer facility would be a floating barge moored to the face of the dam. The facility would include holding pools, a crowder, and a fish hopper. A jib crane on the deck of the dam would be used to load fish into trucks for transport downstream.

Collected fish would be placed back into the river downstream of the Rock Weir below Bull Run Dam No. 2. It is assumed that fish sampling and evaluation facilities would not be required.

Bull Run No. 2 Surface Collector

The Bull Run No. 2 outlet works include two intake towers with tunnels and associated control features. The power/flood intake tower (north tower) supplies water to the powerhouse and the downstream diversion pool via two 42-inch diameter Howell-Bunger valves. The water supply intake tower (south tower) supplies water to the downstream diversion pool via a 48-inch diameter Howell-Bunger valve or directly into the water transmission system. The powerhouse located at the toe of the dam has an installed capacity of 12 MW. An un-gated side channel spillway is located south of the dam.

Operating levels in the Bull Run No. 2 Reservoir can fluctuate 20 feet, but typically vary 14.5 feet between approximate elevation 845.5 and the side channel spillway crest of 860.0 feet.

The Bull Run No. 2 gulper would be similar to that proposed for Bull Run No. 1 and would be placed in the reservoir as shown on Figure 5. The Bull Run No. 2 gulper would also draw approximately 500 cfs from the surface of the reservoir.

The fish transfer facility at Bull Run No. 2 would be a floating barge accessed via a dock in the vicinity of the existing boat ramp. The facility would include holding pools, a crowder, and a fish hopper. Trucks would be driven out on the dock to be loaded by a jib crane.

Collected fish would be placed back in the river downstream of the Rock Weir. It is assumed that fish sampling and evaluation facilities would not be required.

Conceptual Costs

Conceptual construction and project costs were prepared for each alternative. The costs were developed by scaling actual construction costs from similar projects. No detailed facility layouts or material quantity estimates were prepared. A construction contingency of 30 percent is applied.

Present worth annual operations and maintenance (O&M) costs were developed using a real discount rate of 6.6 percent over a period of 50 years. The costs do not include lost generation during construction and are reported in year 2007 dollars. A summary of conceptual costs is provided in Table 2.

Table 2
Conceptual Cost Summary

Proposed Facility	Estimated Construction Cost	Estimated Project Cost	Present Worth Annual O&M Costs	Total Estimated Project Cost
Rock Weir Trap	$ 3,543,000	$ 4,429,000	$ 2,485,000	$ 6,914,000
Bull Run No. 1 Trap	$ 6,663,000	$ 8,329,000	$ 2,761,000	$ 11,090,000
Bull Run No. 1 Gulper	$ 7,469,000	$ 9,336,000	$ 6,466,000	$ 15,802,000
Bull Run No. 2 Gulper	$ 8,119,000	$ 10,149,000	$ 5,987,000	$ 16,136,000
Total:	$ 25,794,000	$ 32,243,000	$ 17,699,000	$ 49,942,000

Summary

To maximize fish production in the upper Bull Run River, upstream and downstream fish passage facilities would be required at Bull Run Dam No. 1 and Bull Run Dam No. 2. It is recommended that trap and haul facilities be provided to transport adults upstream, and that floating surface collectors be provided to collect juveniles migrating downstream. The total construction cost for the program would be approximately $26M and the total project cost would be approximately $50M.

References

CH2M HILL. March 2007. Bull Run Water Supply Habitat Conservation Plan. Prepared for the City of Portland, Oregon Bureau of Water Works.

CH2M HILL. February 2005. Sandy River Basin Characterization Report. Prepared for the Sandy River Basin Agreement Partners.

City of Portland and Mobrand Biometrics. August 2004. Development and Application of the EDT Database and Model for the Sandy River Basin.

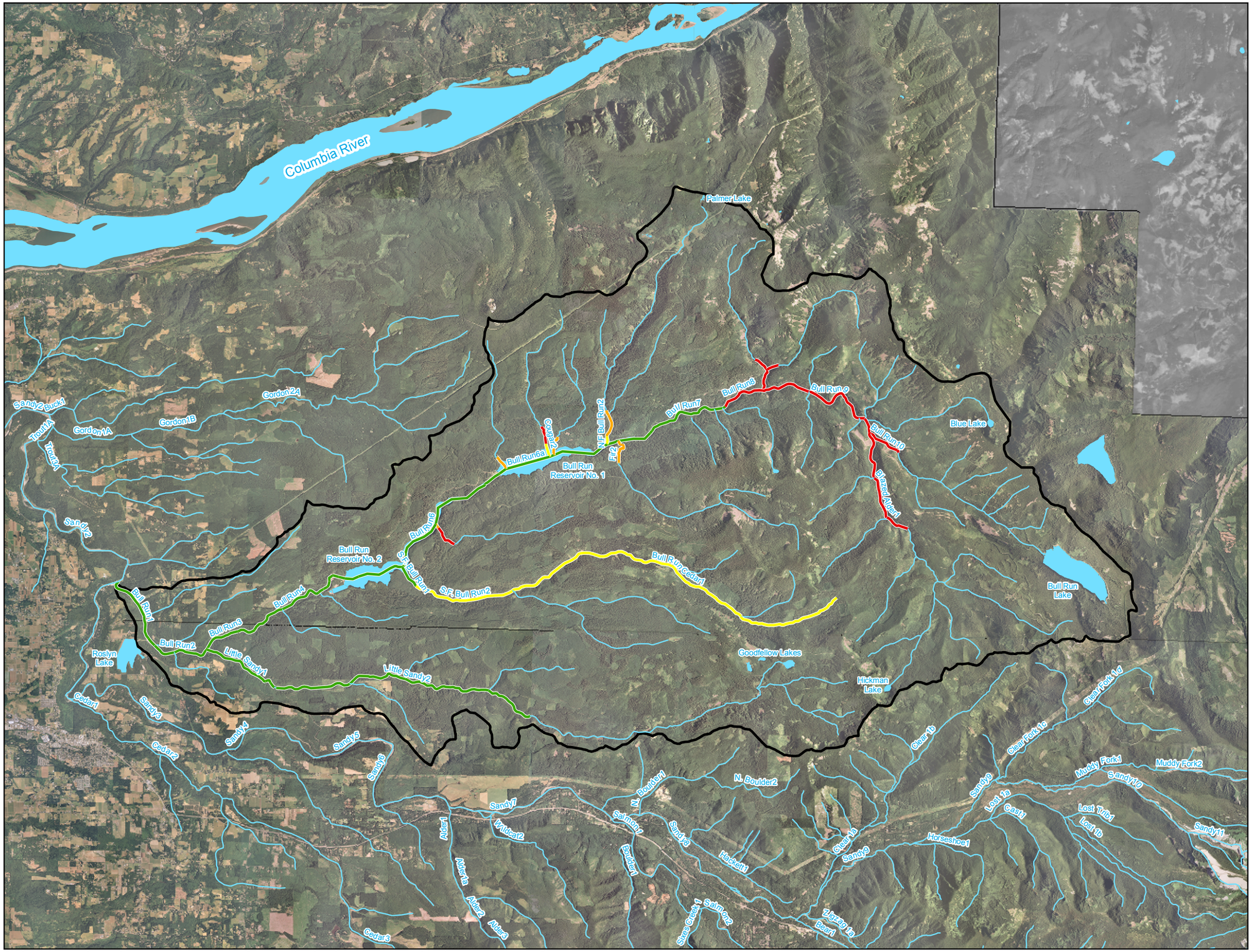
Fisheries Consultants. March 1998. Consideration of Salmon and Steelhead Production Upstream of the Bull Run River Projects. Prepared for the City of Portland, Oregon Bureau of Water Works.

Fisheries Consultants. May 2003. Potential Anadromous Fish Production Above Bull Run River Projects. Memorandum from Paul Tappel to Steve Kucas, City of Portland, Oregon Bureau of Water Works.

URS Corporation. April 2005. Bull Run Dam No. 2 Stilling Basin Rehabilitation and Improvements Preliminary Engineering. Prepared for the City of Portland, Oregon Bureau of Water Works.

Figure 1

Bull Run Watershed
Bull Run HCP EIS



LEGEND

Total Number of Species Anticipated to Use the Reach

- 1
- 2
- 3
- 4
- Not Rated
- Lakes and Reservoirs
- Bull Run HUC

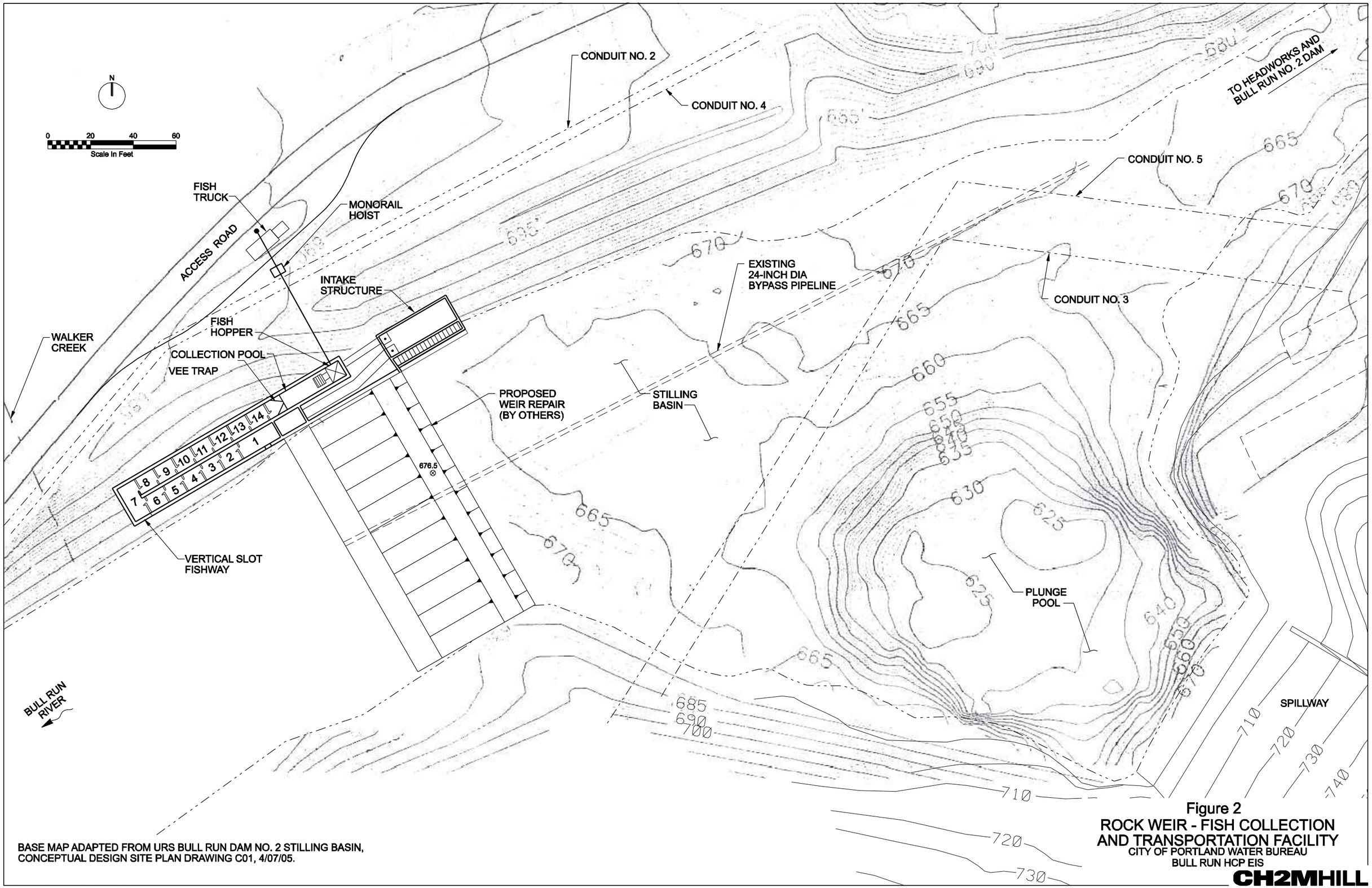
Photo Source: USDA, 2005

N

0 2 4
Miles

CH2MHILL

File Path: \\rosa\proj\PortlandBureauOfWate\181353\GIS\MapDocuments\Bull_Run_DistanceScores.mxd, Date: March 23, 2007 3:35:49 PM



BASE MAP ADAPTED FROM URS BULL RUN DAM NO. 2 STILLING BASIN, CONCEPTUAL DESIGN SITE PLAN DRAWING C01, 4/07/05.

Figure 2
ROCK WEIR - FISH COLLECTION AND TRANSPORTATION FACILITY
CITY OF PORTLAND WATER BUREAU
BULL RUN HCP EIS

CH2MHILL

RockWeir_TRAP_Figure 1.dgn

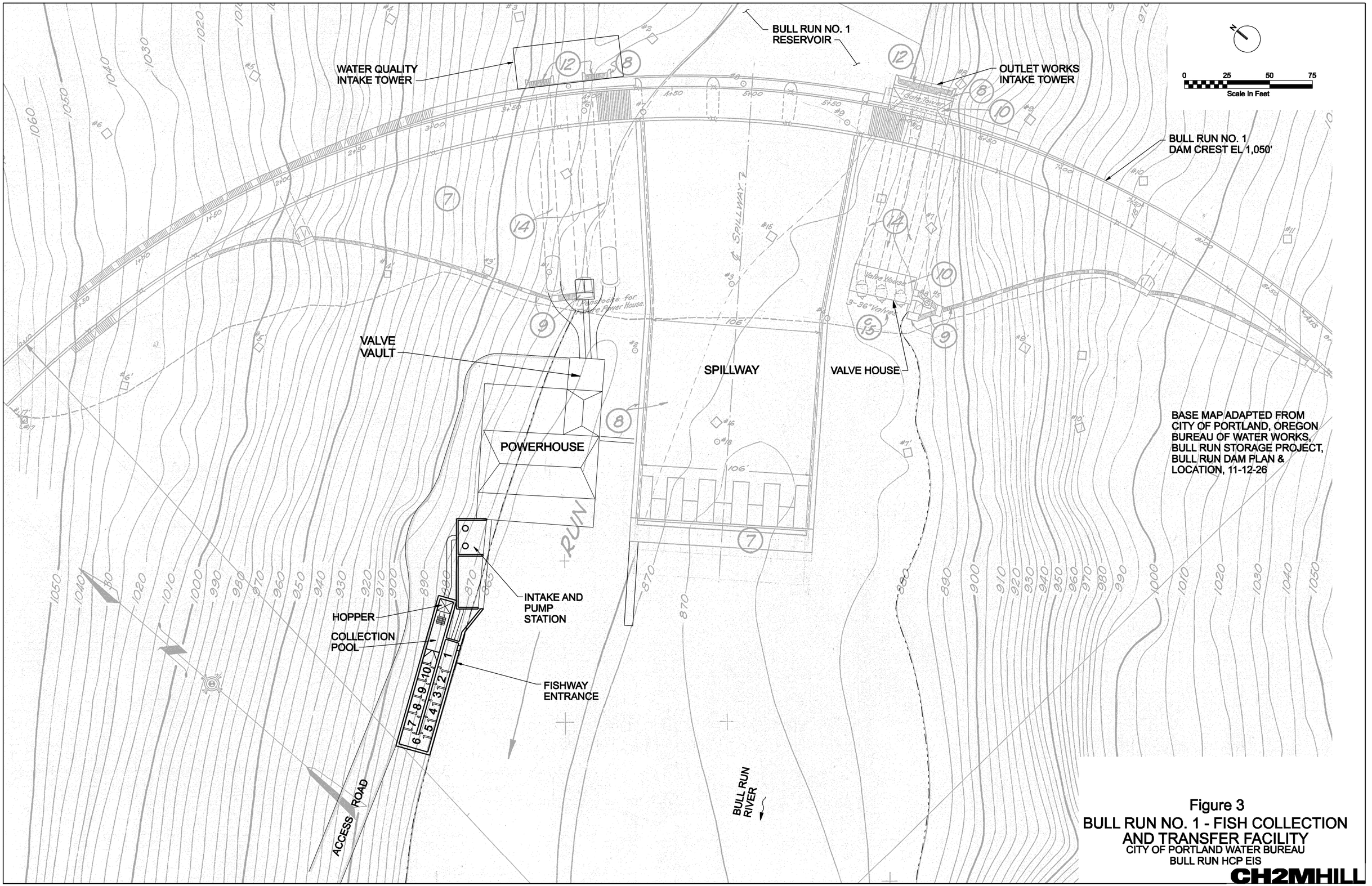


Figure 3
BULL RUN NO. 1 - FISH COLLECTION AND TRANSFER FACILITY
CITY OF PORTLAND WATER BUREAU
BULL RUN HCP EIS

CH2MHILL

Bull_Run1_TRAP_Figure3.dgn

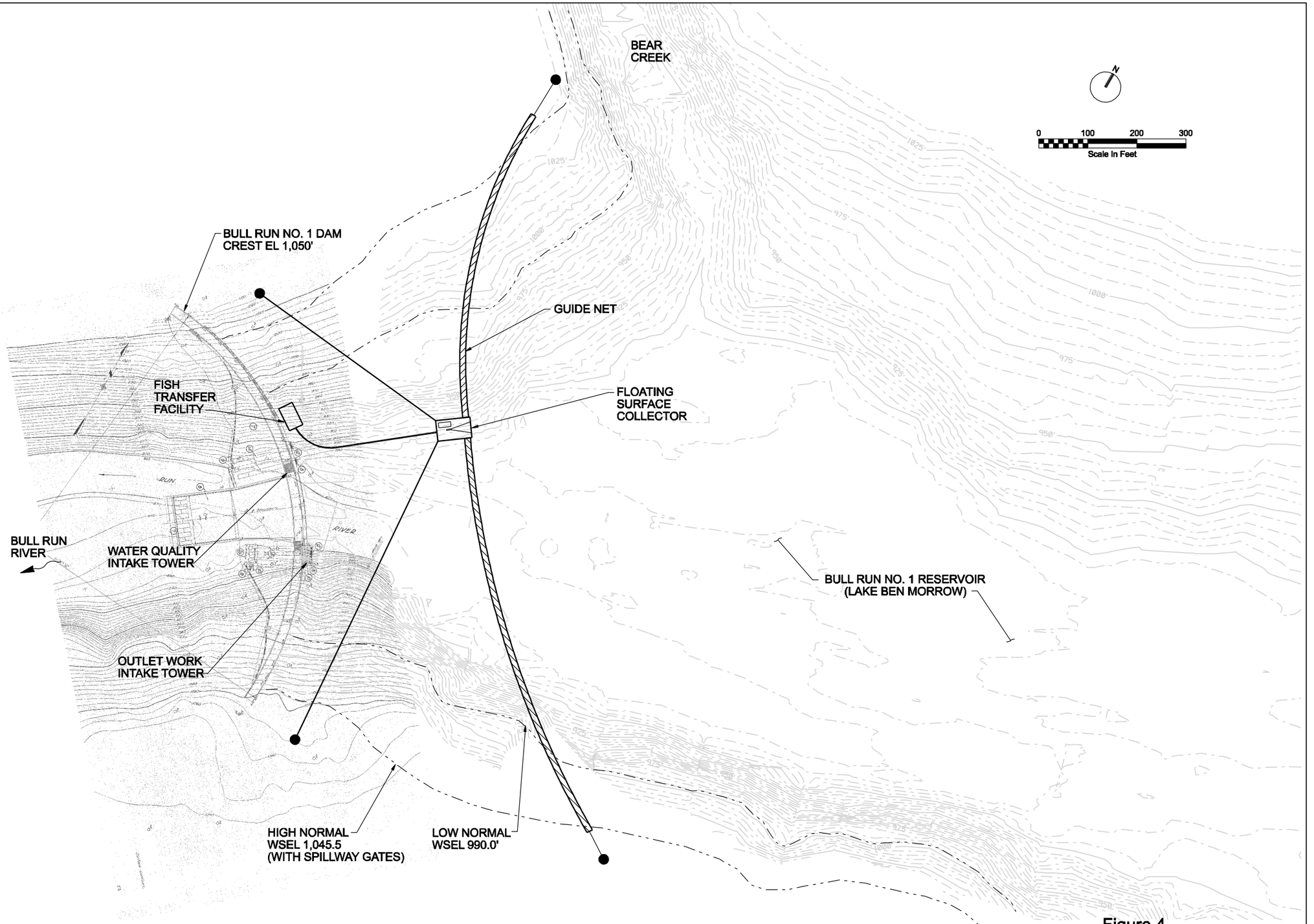


Figure 4

BULL RUN NO. 1 - SURFACE COLLECTOR

CITY OF PORTLAND WATER BUREAU

BULL RUN HCP EIS

CH2MHILL

Bull_Run1_Gulper_Figure 4.dgn

N

0 100 200 300
Scale In Feet

BOAT HOUSE

FISH TRANSFER FACILITY

GUIDE NET

HEADWORKS INTAKE

VALVE STRUCTURE

VALVE STRUCTURE

DIVERSION POOL

POWERHOUSE

BULL RUN NO. 2 DAM CREST EL 875.0

POWER/FLOOD DIVERSION TUNNEL

FLOATING SURFACE COLLECTOR

NORTH INTAKE TOWER

SOUTH INTAKE TOWER

BULL RUN NO. 2 RESERVOIR

WATER SUPPLY DIVERSION TUNNEL

ACCESS ROAD

LOW NORMAL WSEL 845.5

HIGH NORMAL WSEL 860.0

SPILLWAY APPROACH CHANNEL

Figure 5
BULL RUN NO. 2 - SURFACE COLLECTOR
CITY OF PORTLAND WATER BUREAU
BULL RUN HCP EIS

CH2MHILL

Bull_Run2_Gulper_Figure 2.dgn